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REPORT

TO THE

Hon. CYRUS C. MILLER

President of the Borough of The Bronx

ON

White Plains Road Experimental Pavements

BY

WILLIAM H. CONNELL
Assistant Commissioner of Public Works

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CITY OF NEW YORK,
PRESIDENT OF THE BOROUGH OF THE BRONX,
THIRD AVENUE AND 177TH STREET.
March 16, 1911.

Hon. CYRUS C. MILLER,
President of the Borough of The Bronx.

DEAR SIR—The provisions of the bill submitted to the Legislature by you amending the Greater New York Charter with regard to street pavements, which became a law on June 20, 1910, has made it possible to lay a medium-priced pavement on streets where the value of the abutting property is not sufficient to warrant an assessment for a high-priced first-class pavement. Therefore it was deemed advisable to lay a number of sections of medium-priced pavements on the White Plains Road experimental roadway that would come under the head of Class B. Pavements as provided for in the following Act amending the Greater New York Charter referred to above:

AN ACT

To amend the Greater New York Charter, in relation to the pavement of streets and the payment of the cost thereof.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. Section nine hundred and forty-eight of the Greater New York charter, as re-enacted by chapter four hundred and sixty-six of the laws of nineteen hundred and one, is hereby amended to read as follows:

Paving and repaving of streets; character of materials; and method of payment therefor.

SEC. 948. Street pavements shall be divided into two classes, namely: Class "A" or permanent pavements, and Class "B" or preliminary pavements. Class "A" shall include all pavements of sheet asphalt, asphalt block, wood block, granite block, or other materials that shall, from time to time, be designated for this class by the board of estimate and apportionment. Class "B" shall include all pavements of bituminous macadam and such other pavements of less cost than those used in class "A" pavements, that shall from time to time be designated for this class by the board of estimate and apportionment.

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No street, or portion thereof, that shall have been paved with class "A" pavement shall be repaved at the expense of the adjoining property-owners, unless a majority of the owners of the property on the line of the proposed improvement shall petition for such repaving at their expense by assessment.

Whenever a street paved with class "B" pavement shall be repaved, the repaving shall be done with class "A" pavement, unless owners of property on the line of the proposed improvement petition the local board having jurisdiction for a second class "B" pavement, to be laid at the expense, by assessment, of the adjoining property-owners, and in such event second class "B" pavement shall be laid if said local board so orders, and the board of estimate and apportionment consents. Whenever a class "A" pavement shall be laid to replace a class "B" pavement that has been laid at the expense of the property-owners by assessment, there shall be deducted from the cost of such improvement the cost of the class "B" pavement, and the difference shall be paid by assessment upon the adjoining property, and the amount equal to the cost of said class "B" pavement shall be borne and paid by the city. But in no case shall the cost of a second or additional class "B" pavement be so deducted from the amount to be assessed for the laying of a permanent or class "A" pavement.

The class of the original pavement of any street shall in all cases be determined by the local board having jurisdiction and the board of estimate and apportionment.

Nothing herein contained shall be construed to relieve or release the owners of property, grantees of the city of New York, of or from any covenants to pave or repave or otherwise physically to improve any street or streets.

The following is a description of the White Plains Road experimental pavements, which was presented by the writer at a special meeting of the American Society of Civil Engineers on road construction and maintenance on January 21, 1911, and is embodied in the Proceedings of the American Society of Civil Engineers, Vol. XXXVII., No. 3, pp. 368, 376, 394 (March, 1911).

"The White Plains Road experimental pavements consist of eighteen sections, ranging in length from 100 feet to 350 feet, with a width of 21 feet. Fourteen of these sections comprise the Bituminous Pavement Group, two of which consist of a wearing surface of broken stone and sand with an asphaltic binder, built by the mixing method and laid on a concrete foundation. The

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wearing surfaces of twelve sections were laid on a broken stone foundation, five built by the penetration and seven by the mixing method. In all but one section built by the mixing method the stone was heated. The remaining four are made up as follows: Hassam Portland Cement Concrete Pavement, Water Bound Macadam, Sicilian Asphalt Company's Asphalto, which in appearance resembles ground Kentucky Rock Asphalt, and a Surface Application of Asphalt Binder and Sand on an old Macadam Strip. In all but one section, where paving gravel was used in the wearing surface, the stone, both for foundation and wearing surface, was Clinton Point Crushed Trap Rock.

"These experiments were made with a view to determining, by a service test, a suitable medium-priced pavement for suburban residential streets, and also a cheaper grade of pavement for country roads and parkways, where the constantly increasing automobile traffic has made it imperative to lay something better than a water bound macadam pavement, which it has been clearly demonstrated will not stand up under automobile traffic. Therefore it is to be hoped that the information obtained through observation of these experiments will be of value, both from an engineering as well as an economic point of view, as the maintenance cost of water bound macadam subjected to automobile traffic is appalling, and consequently it will be necessary in future to construct a pavement where, even though the initial cost may be a little higher, the maintenance will be very much lower.

"Accurate cost data has been kept of the construction of the various sections, and cost data will also be kept of the maintenance.

"An analysis has been made of the bituminous binders used, by the United States Office of Public Roads, in accordance with their methods of testing bituminous binders, and also by chemists in accordance with the recommendations of the Special Committee of the American Society of Civil Engineers on Bituminous Materials for Road Construction. Levels have been taken which will make it possible to ascertain the amount of wear at any time.

"White Plains Road is a wide thoroughfare extending northeasterly through the northerly section of the Borough of The Bronx to Mount Vernon, and on toward White Plains. The experimental roadway is laid on the east side of the road, and extends from the intersection of White Plains Avenue and Boston

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Road to Burke Street, a distance of 4,120 feet. The maximum grade is 1 per cent. and the crown ⅜ inch to 1 foot. No streets intersect White Plains Road between Boston Road and Burke Street, therefore all the sections will be subjected to the same amount of traffic, of which a careful census will be taken from time to time. A double-track electric railway runs along White Plains Avenue, and the pavement is carried up to the outside girder rail of the track.

"The water bound macadam section was laid as a basis of comparison, both with regard to wear and cost of construction, as the cost of experimental work of this character where the sections are short and all differ in methods of construction is necessarily high, as the organization is hardly perfected and making satisfactory progress before the section is completed, so it may be safe to assume that the excess cost of the water bound macadam may be used to determine the percentage to be deducted from the actual cost of any other section, in order to ascertain its normal cost.

"Work on the experimental road was begun on September 29, 1910, and was completed on November 22, 1910. The number of sections under construction at the same time ranged from two to nine. It will be observed from the lateness of the season and daily record of the temperature taken during the period of construction, that the work was not done under the most favorable conditions. The temperature when the work was in progress varied from 40 degres to 79 degrees, the average being 57 degrees. It was thought, however, better to make a start and finish this season than wait about nine months for more perfect conditions.

"It is to be observed that the labor item is somewhat high, even for experimental work of this character. This, however, may be partially attributed to the fact that the nature of the work was entirely new to the Foreman as well as the men, consequently this should be taken into consideration in the progress made in square yards per day laid.

"There are several points which stand out in evidence in connection with the work that it may be worth while noting, namely, the comparatively low cost of Section 5, where the binder was mixed with cold stone in a concrete mixer; the high cost per square yard for fuel where the stone was heated; the additional cost per square yard for mixing tar and asphalt; the excess of binder used in the seal coat of several sections; the high cost of handling the Amiesite pavement, due entirely to the paving mix-

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ture being stiff—owing to the cold weather; the difference in the cost of the concrete foundations laid by the mixing method and by process of spreading cement and screenings mixed, sprinkling and rolling, as in water bound macadam; the high cost of labor, namely, .054 per square yard, for spreading and rolling the broken stone foundation course, due to rehandling material.

"In conclusion I might add that this work was undertaken primarily with a view to trying out the various bituminous binders and paving mixtures, as it has been conceded for some time past that the methods of construction used on White Plains Road, both for penetration work and the mixing method, were rather crude, and unless a suitable pressure machine is used for penetration work which will insure an equal distribution of bituminous binder, and an economical mixer for heating and mixing the stone and bituminous binder, and thereby decrease the labor cost, the cost of work of this character, employing methods of construction similar to those employed on the greater number of sections on White Plains Road, will be unnecessarily high, in comparison with the cost of water bound macadam. The method of construction, therefore, should be taken into consideration in comparing the relative cost of the various sections with the water bound macadam. At a later date sections of the pavements will be cut out and an examination of the same made by the Office of Public Roads, United States Department of Agriculture.

"Respectfully,

"William H. Connell,
"Assistant Commissioner of Public Works."

The following is a description of the methods of construction and binders used in the various sections, with the unit cost per square yard of the same. Also daily record of the temperature and traffic census report:

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section One—0 + 00 to 3 + 25.

Bituminous Pavement Mixing Method Laid by the Barber Asphalt Company.

Foundation Course—A concrete foundation was laid to a finished depth of 4½ inches in proportions of 1-3-6.

Surface Course or Paving Mixture—The paving mixture consists of the following mineral aggregate by weight: 73 per cent. paving gravel, 19½ per cent. sand, 1½ per cent. dust, and 5.4 per cent. Bermudez asphalt, 55 penetration. The mixing was done at the Barber asphalt plant, then laid at a temperature of 220 degrees and rolled to a finished depth of 1¾ inches with a ten-ton roller.

Seal Coat—From 0 + 00 to 1 + 52, ¼ gallon, of asphaltic cement to the square yard was applied, over which sand was spread.

Cost Per Square Yard.

Concrete Foundation	$0.639
Surface Course	0.715
Seal Coat	0.085
	$1.439

Detailed Cost Per Square Yard.

Concrete Base—4½ inches thick.

		Per Sq. Yd.		Labor. No.	Hours.	Rate.	
Labor	$168.00	$0.219	Foreman	1	24	$5.00	$15.00
1½-inch trap rock, 86 cubic yards, at $1.65	141.90	0.185	Laborers	22	528	1.75	115.50
Sand, 43 cubic yards, at $1.21	52.03	0.068	Watchmen	2	48	1.75	10.50
Cement, 95 barrels, at $1.35	128.25	0.167	Timekeeper	1	24	3.00	9.00
			Team	1	24	6.00	18.00
767 square yards, at $0.639	$490.18	$0.639					$168.00

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Surface Course.

		FIELD LABOR. No.	Hours.	Rate.	
Cost about 71½ cents per square yard. Estimated from cost of Bronx, 55 degrees penetration, deducting $27 for difference in cost of gravel and trap rock.	Foreman	1	8	$5.00	$5.00
	Laborers	12	96	1.75	21.00
	Watchman	1	8	1.75	1.75
	Tampers	4	32	2.50	10.00
	Rakers	3	24	2.50	7.50
	Smoothers	2	16	2.00	4.00
	Rollerman	1	8	4.50	4.50
	Timekeeper	1	8	3.00	3.00
	767 square yards, at $0.074				$56.75

Seal Coats.

		Per Sq. Yd.		LABOR. No.	Hours.	Rate.	
Labor	$9.22	$0.026	Foreman	1	4	$5.00	$2.50
Chips, 5 cubic yards, at $1.90.	9.50	0.027	Pouring Asphalt	2	6	2.25	1.68
Binder, 89 gallons, at $0.131..	11.66	0.032—.248 gals. per sq. yd.	Squegee	1	3	2.25	.84
			Heating Asphalt	1	3	2.25	.84
			Carrying Asphalt	2	6	2.25	1.68
359 square yards, at $0.085	$30.00	.....	Spreading Chips	2	6	2.25	1.68
							$9.22

Actual time for laying surface course, eight hours, or an average of 767 square yards per day.
Actual time for laying seal coat, three hours, or an average of 957 square yards per day.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Two—3 + 25 to 6 + 50.

Bituminous Pavement Mixing Method Laid in Accordance with Borough of The Bronx Specifications.

Foundation Course—1½-inch crushed trap rock was spread and thoroughly rolled with an eighteen-ton roller to a finished depth of about 3¾ inches.

Surface Course or Paving Mixture—The paving mixture is composed of two parts crushed trap rock passing through a 1¼-inch ring and not containing more than 5 per cent. dust, one part sand and 7.4 per cent. by weight of Bermudez asphalt 55 penetration. The mixing was done at an asphalt plant and the paving mixture laid at a temperature of 220 degrees and rolled to a finished depth of 2½ inches with a ten-ton roller.

Seal Coat—From 3 + 25 to 4 + 78, ¼ gallon of asphaltic cement to the square yard was applied, over which chips were spread and rolled.

Cost Per Square Yard.

Base Course	$0.283
Surface Course	0.751
Seal Coat	0.081
	$1.115

Detailed Cost Per Square Yard.

Base 3¾ inches thick.

		Per Sq. Yd.
106.4 cubic yards Trap Rock, at $1.65	$175.56	$0.229
Labor		0.054
		$0.283

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Surface Course.

		Per Sq. Yd.	FIELD LABOR.	No.	Hours.	Rate.	
Mixing at plant	$110.48	$0.144	Foreman	1	8	$5.00	$5.00
Labor, Field	51.25	0.067	Laborers	8	64	1.75	14.00
Hauling	93.84	0.122	Watchmen	3	24	1.75	5.25
Asphalt Cement, 1,600 gallons, at $0.131	209.60	0.273—2.09 gals. per sq. yd.	Tampers	4	32	2.50	10.00
¾-inch Trap Rock, 54 cubic yards, at $1.25	67.50	0.088	Rakers	3	24	2.50	7.50
Sand, 30½ cubic yards, at $0.75	22.87	0.030	Smoothers	1	8	2.00	2.00
Dust, 2,760 pounds, at $3.50	4.83	0.006	Rollerman	1	8	4.50	4.50
Grit, 3 cubic yards, at $1.25	3.75	0.005	Timekeeper	1	8	3.00	3.00
Coal, 8,030 pounds, at $3.00	12.05	0.016					
767 square yards at $0.751	$576.17	$0.751	767 square yards, at $0.067				$51.25

Seal Coat.

		Per Sq. Yd.	LABOR.	No.	Hours.	Rate.	
Labor	$9.52	$0.026	Heating Asphalt	1	11	$1.75	$2.38
Chips, 3 cubic yards, at $1.90	5.70	0.016	Pouring Asphalt	1	11	1.75	2.38
Asphalt Cement, 95 gallons, at $0.13	12.35	0.035—0.26 gals. per sq. yd.	Spreading Chips	2	22	1.75	4.76
Wood, ¼ cord, at $6.50	1.62	0.004					$9.52
361 square yards, at $0.081	$29.19	$0.081					

Actual time for laying surface course, eight hours, or an average of 767 square yards per day.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Three—6 + 50 to 8 + 00.

Foundation Course—A concrete base was laid under the supervision of C. I. Williams, of Utica, N. Y., to a finished depth of 4¾ inches. 1½-inch stone was spread to a depth of 6 inches; then screenings and cement mixed dry in proportions of 3-1 were spread, rolled, and sprinkled with water, the operation was repeated until the voids were filled. An eighteen-ton roller was used.

Paving Mixture or Surface Course—The paving mixture is composed of two (2) parts crushed trap rock passing through a 1¾-inch ring and not containing more than 5 per cent. dust, 1 part sand, and 8 per cent. Bermudez asphalt, 55 penetration. The mixing was done at an asphalt plant and the paving mixture was laid at a temperature of 220 degrees and rolled to a finished depth of 2 inches with a ten-ton roller.

Seal Coat—The surface coat was painted with about ¼ of a gallon of asphaltic cement to the square yard, over which chips were spread and rolled.

Cost Per Square Yard.

Concrete Foundation	$0.502
Surface Course	.90
Seal Coat	.08
	$1.482

Detailed Cost Per Square Yard.

Concrete Base—4¾ inches to 5 inches thick.

		Per Sq. Yd.	Labor.	No.	Hours.	Rate.	
Labor	$19.96	$0.056	Foreman	1	9	$4.00	$4.50
1½-inch trap rock, 59 cubic yards, at $1.65	97.35	0.275	Laborers	5	43	2.25	12.09
Screenings, 9.0 cubic yards, at $1.65	14.85	0.042	Rollerman	1	6	4.50	3.37
Cement, 20¼ barrels, at $1.35	27.34	0.077					$19.96
354 square yards, at $0.45	$159.50	$0.450					
Spreading 1½-inch stone		0.054					
Total		$0.504					

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Surface Course.

		Cost Per Sq. Yd.		FIELD LABOR.	No.	Hours.	Rate.	
Mixing at Plant	$105.14	$0.297		Foreman	1	6	$5.00	$3.75
Labor, Field	32.06	0.090		Laborers	8	48	1.75	10.50
Hauling	40.80	0.115		Watchmen	1	6	1.75	1.31
Asphalt Cement, 742.5 gallons,				Tampers	2	12	2.50	3.75
at $0.13	96.52	0.273—	2.1 gals. per sq. yd.	Rakers	3	18	2.50	5.62
				Smoothers	1	6	2.00	1.50
Trap Rock, 22.5 cubic yards,				Rollerman	1	6	4.50	3.38
at $1.25	28.12	0.079		Timekeeper	1	6	3.00	2.25
Sand, 9.0 cubic yards, at $0.75	6.75	0.020						
Dust, 1,440 pounds, at $3.50	2.52	0.008		354 square yards, at $0.090				$32.05
Coal, Soft, 5,300 pounds, at $3.00	7.95	0.022						
Coal, Hard, 400 pounds, at $6.00	1.20	0.003						
354 square yards, at $0.907	$321.06	.....						

Seal Coat.

		Cost Per Sq. Yd.		LABOR.	No.	Hours.	Rate.	
Labor	$8.80	$0.025		Heating Asphalt	1	6	$1.75	$1.31
Chips, 3 cubic yards, at $1.90	5.70	0.016		Poring Asphalt	2	12	1.75	2.62
Asphalt Cement, 82.5 gallons,				Spreading Chips	2	12	1.75	2.62
at $0.13	10.72	0.030—	.23 gals. per sq. yd.	Timekeeper	1	6	3.00	2.25
Wood, ½ cord, at $6.50	3.25	0.010		354 square yards, at $0.025				$8.80
354 square yards, at $0.080	$28.47	.....						

Actual time for laying surface course five hours, or an average of 454 square yards per day.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Four—8 + 00 to 11 + 25.

Bituminous Pavement Mixing Method Laid Under the Supervision of the Standard Oil Company.

Foundation—1½-inch crushed trap rock was spread and thoroughly rolled with an eighteen-ton roller to a finished depth of about 3¾ inches.

Surface Course or Paving Mixture—The paving mixture consists of the following mineral aggregate by weight: 58 per cent. ¾-inch trap rock, 20 per cent. ⅜-inch chips, 15 per cent. sand and 7 per cent. Standard Oil Company special asphalt binder. The binder, trap rock and sand were heated on the ground and mixed by hand on mixing boards, the mixture was spread and rolled to a finished depth of 2¾ inches with an eighteen-ton roller.

Seal Coat—From 9 + 95 to 10 + 66, ⅓ gallon to the square yard was applied, over which chips were spread and rolled.

Cost Per Square Yard.

Base Course	$0.283
Surface Course	0.964
Hauling Binder	0.009
Fuel	0.063
Asphalt and Stone Heaters	0.004
	$1.323

Detailed Cost Per Square Yard.

Base—3¾ inches thick.

		Per Sq. Yd.
106.4 cubic yards Trap Rock, at $1.65	$175.56	$0.229
Labor	.....	0.054
	.....	$0.283

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Surface Course.

		Per Sq. Yd.		FIELD LABOR.	No.	Hours.	Rate.	
Labor	$368.14	$0.480		Foreman	1	24	$4.00	$12.00
¾-inch Trap Rock, 60 cubic yards, at $1.80	108.00	0.140		Foremen	2	48	4.00	24.00
Chips, 18 cubic yards, at $1.90	34.20	0.045		Spreading	1	24	2.25	6.75
Sand, 12 cubic yards, at $1.21	14.52	0.019		Spreading	2	48	2.25	13.50
Binder, 2,688 gallons, at $0.08	215.04	0.280—3.5 gals. per sq. yd.		Mixing	8	192	2.25	54.00
				Mixing	4	108	2.25	30.37
				Wheeling	6	280	2.25	78.75
				Heating and Carrying Oil	4	96	2.25	27.00
				Heating and Carrying Oil	5	120	2.25	33.75
				Heating Stone	5	235	2.25	66.09
				Rollerman	3	39	4.50	21.93
767 square yards, at $0.964	$739.90	$0.964		767 square yards, at $0.480				$368.14

First three days one gang worked. Last three days two gangs worked.

Total laid, 767 square yards, or an average of 85 square yards laid per day per gang.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Five—11 + 25 to 14 + 50.

Bituminous Pavement Mixing Method Laid Under the Supervision of the Texas Co.

Foundation Course—1½-inch crushed trap rock was spread and thoroughly rolled with an eighteen-ton roller to a finished depth of about 3¾ inches.

Surface Course or Paving Mixture—The paving mixture consists of ¾-inch trap rock and 6.7 per cent. by weight of Texas macadam binder. The binder was heated and mixed with the cold stone in a standard concrete mixer on the ground. The paving mixture was spread and rolled with an eighteen-ton roller to a finished depth of 2¾ inches.

Seal Coat—From 12 + 36 to 13 + 03, a seal coat of Texas 55 special, about 1¼ gallons to the square yard, was applied, over which chips were spread and rolled.

Cost Per Square Yard.

Base Course	$0.283
Surface Course	0.721
Tar Heater	0.001
Fuel	0.021
Hauling Binder	0.006
	$1.032

Detailed Cost Per Square Yard.

Base—3¾ inches thick.

		Per Sq. Yd.
108.6 cu. yds. trap rock at $1.65	$179.19	$0.229
Labor		0.054
		$0.283

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SURFACE COURSE.

		Per Sq. Yd.		FIELD LABOR.	No.	Hours.	Rate.	
Labor	$182.86	$0.234		Foreman	1	44	$4.00	$22.00
¾-in. Trap Rock, 81 cubic yards,				Spreading	2	90	2.25	25.31
at $1.80	145.80	0.186		Feeding Mixer	4	171	2.25	48.09
Binder, 1728 gallons, at $0.12	207.36	0.265—2.2 gals. per sq. yd.		Wheeling	3	132	2.25	37.12
				Wheeling	3	25	2.25	7.03
Concrete Mixer (rent), 7 days,				Heating Binder	1	48	2.25	13.50
at $4.00	28.00	0.036		Rollerman	1	9	4.50	5.06
				Mixer Engineer	1	44	4.50	24.75
782 square yards, at $0.721	$564.02	$0.721		782 square yards, at $0.234				$182.86

Actual time for laying surface course, five days and four hours, or an average of 142 square yards per day.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Six—14 + 50 to 17 + 75.

Amiesite Laid Under the Supervision of the Amiesite Co.

Foundation Course—1½-inch crushed trap rock and sufficient screenings to fill the voids was spread and rolled with an eighteen-ton roller to a finished depth of 3½ inches.

Surface Course or Paving Mixture—The paving mixture was shipped from the Amiesite plant and laid in two courses, the first course was composed of 1½-inch stone with binder, etc., laid and rolled to a finished depth of two inches. The second or wearing course was composed of ⅝-inch trap rock, binder, etc., laid and rolled to a finished depth of 1 inch. The paving mixture therefore had a finished depth of three inches. An eighteen-ton roller was used.

Cost Per Square Yard.

Base Course	$0.329
Surface Course.	
Labor Spreading	0.155
Labor Unloading	0.132
Hauling	0.179
	$0.795

Detailed Cost Per Square Yard.

Base—3½ inches thick.

		Per Sq. Yd.
106.4 cubic yards Trap Rock, at $1.65	$175.56	$0.229
21.3 cubic yards Screenings, at $1.65	35.11	0.046
Labor		0.054
		$0.329

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Surface Course.

FIELD LABOR.

	No.	Hours.	Rate.
Foreman	1	21	$4.00
Laborers	17	356	2.25
Rollerman	1	15	4.50
766 square yards, at $0.155			$119.05

Screenings, 1½ cubic yards, at $1.65... $2.47 $0.003 per sq. yd.

LABOR UNLOADING FROM R. R. CARS.
72 Cubic Yards Amiesite.

	No.	Hours.	Rate.	
Foreman	1	34	$4.00	$17.00
Laborers	9	297	2.25	83.00
766 square yards, at $0.132				$100.90

HAULING FROM R. R. DEPOT.

	No.	Hours.	Rate.	
Teams	3	15	$5.00	$9.38
Teams	7	56	5.00	35.00
Teams	9	27	5.00	16.88
Teams	6	21	5.00	13.12
Teams	8	52	5.00	32.50
Teams	3	12	5.00	7.50
Teams	3	24	5.00	15.00
Teams	4	13	5.00	8.12
766 square yards, at $0.179				$137.50

Actual time for laying surface course, two days, four hours, or an average of 306 square yards per day.

Material was very hard, due to the length of time in cars, making work on ground and in unloading from cars very difficult. Under favorable conditions labor should be reduced 70 per cent.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Seven—17 + 75 to 20 + 67.

Sicilian Asphalt Laid by the Sicilian Asphalt Co.

Foundation Course—Consists of 1½-inch crushed trap rock laid and rolled with an eighteen-ton roller to a finished depth of 4½ inches.

Surface Course of Paving Mixture—The paving mixture is called Asphalto and was mixed at the Sicilian Asphalt Company's plant and hauled to White Plains avenue and spread. The paving mixture was not rolled until comparatively cool with a Sicilian asphalt ten-ton grooved roller, to a finished depth of 1½ inches. A light layer of cement was then sprinkled over the surface.

Cost Per Square Yard.

Base Course	$0.382
Surface Course.	
Field Labor	0.030
Cement	0.001
Hauling	0.087
	$0.500

Detailed Cost Per Square Yard.

Base—4½ inches thick.

		Per Sq. Yd.
129.9 cubic yards Trap Rock at $1.65	$214.33	$0.299
13.0 cubic yards Screenings, at $1.65	21.40	0.029
Labor		0.054
		$0.382

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Surface Course.

Field Labor.	No.	Hours.	Rate.	
Foreman	1	5	$5.00	$3.12
Spreading	10	50	1.75	10.93
Rakers	2	10	2.50	3.12
Spreading Cement	1	6	1.75	1.31
Rollerman	1	6	4.50	3.37
718 square yards, at $0.030				$21.85
Cement, 2½ bags, at $1.35 per barrel		$0.840	$0.001 per sq. yd.	
Hauling.				
19 loads, at $3.25		$61.75	$0.087 per sq. yd.	

Actual time for laying surface course five hours, or an average of 1,148 square yards per day.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Eight—20 + 67 to 22 + 75.

Bituminous Pavement Mixing Method Laid Under the Supervision of the Barrett Manufacturing Co.

Foundation Counse—1½-inch. crushed trap rock and screenings was spread and rolled with an eighteen-ton roller to a finished depth of 3¾ inches.

Surface Course or Paving Mixture—The paving mixture consists of 3 parts ¾-inch trap rock, 1 part chips and 6½ per cent. by weight of Tarvia X. The trap rock and Tarvia X were heated on the ground and mixed by hand on mixing boards. spread and rolled with an eighteen-ton roller to a finished depth of 2¾ inches.

Seal Coat—About .6 of a gallon to the square yard of Tarvia X was applied, over which chips were spread and rolled.

Cost Per Square Yard.

Base Course	$0.305
Surface Course	0.913
Seal Coat	0.137
Hauling Binder	0.009
Tar and Stone Heaters	0.002
Fuel	0.063
	$1.429

Detailed Cost Per Square Yard.

Base—3¾ inches thick.

		Per Sq. Yd.
68.1 cubic yardss Track Rock, at $1.65	$112.36	$0.229
6.8 cubic yards Screenings, at $1.65	11.23	0.022
Labor		0.054
		$0.305

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Surface Course.

		Per Sq. Yd.		FIELD LABOR.	No.	Hours.	Rate.	
Labor	$206.60	$0.421		Foreman	1	42	$4.00	$21.00
1½-inch Trap Rock, 6 cubic yards, at $1.65	9.90	0.177		Spreading	1	42	2.25	11.81
¾-inch Trap Rock, 43 cubic yards, at $1.80	77.40	0.177		Mixing	4	169	2.25	47.53
Chips, 14 cubic yards, at $1.90	26.60	0.054		Wheeling	3	142	2.25	39.93
Binder, 1,344 gallons, at $0.095	127.68	0.261—	2.7 gals. per sq. yd.	Heating Binder	2	94	2.25	26.43
				Heating Stone	3	150	2.25	42.19
				Heating Stone	4	29	2.25	8.15
				Rollerman	1	17	4.50	9.56
491 square yards, at $0.913	$448.18	$0.913		491 square yards, at $0.421				$206.60

Seal Coat.

		Per Sq. Yd.		LABOR.	No.	Hours.	Rate.	
Labor	$33.24	$0.068		Foreman	1	8	$4.00	$4.00
Chips, 3.5 cubic yards, at $1.90	6.65	0.014		Pouring Binder	1	8	2.25	2.25
Binder, 288 gallons, at $0.095.	27.36	0.055—	0.58 gals. per sq. yd.	Squegee	1	8	2.25	2.25
				Heating and Carrying Binder	3	26	2.25	7.31
491 square yards, at $0.137	$67.25	$0.137		Spreading Chips	2	16	2.25	4.50
				Wheeling and Heating Chips	4	32	2.25	9.00
				Rollerman	1	7	4.50	3.93
								$33.24

Actual time for laying surface course six days two hours, or an average of 78½ square yards per day.
Actual time for laying seal coat one day, or an average of 491 square yards per day.
Chips required heating, were wet and cold.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Nine—22 + 75 to 24 + 50.

Bituminous Pavement Mixing Method.

Foundation Course.—1½-inch crushed trap rock and screenings were spread and rolled to a finished depth of 3¾ inches.

Surface Course or Paving Mixture—From 22 + 75 to 23 + 02, the binder consists of a mixture, tar and 10 per cent. of refined Bermudez asphalt. From 23 + 02 to 24 + 00, the binder consists of a mixture of tar and 15 per cent. of Bermudez asphalt of 60 penetration. From 24 + 00 to 24 + 40, the binder consists of a mixture of tar and 15 per cent. of Bermudez asphalt of 110 penetration. From + 40 to 24 + 50, Bermudez asphalt of 110 degrees penetration was used for a binder. The paving mixture consists of 3 parts ¾-inch trap rock, 1 part chips and 7 per cent. by weight of bitumen. The stone and binder were heated on the ground, mixed by hand on mixing boards, spread and rolled with an eighteen-ton roller to a finished depth of 2¾ inches.

Seal Coat—About .6 of a gallon of asphalt per square yard was applied, over which chips were spread and rolled.

Cost Per Square Yard.

Base Course	$0.305
Surface Course	1.034
Seal Coat	0.146
Fuel	0.063
Hauling Binder	0.009
Tar and Stone Heaters	0.002
Mixing Binder	0.076
	$1.635

Detailed Cost Per Square Yard.

Base—3¾ inches thick.

		Per Sq. Yd.
57.3 cubic yards Trap Rock, at $1.65	$94.54	$0.229
5.7 cubic yards Screenings, at $1.65	9.45	0.022
Labor		0.054
		$0.305

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Surface Course.

		Per Sq. Yd.
Labor	$197.84	$0.479
1½-inch Trap Rock, 5 cubic yards, at $1.65	8.25	0.181
¾-inch Trap Rock, 37 cubic yards, at $1.80	66.60	
Chips, 12 cubic yards, at $1.90	22.80	0.055
Binder, 1,115 gallons, at $0.118	131.57	0.319—2.7 gals. per sq. yd.
413 square yards, at $1.034	$427.06	$1.034

Field Labor.	No.	Hours.	Rate.	
Foreman	1	47	$4.00	$23.50
Spreading	1	46	2.25	12.93
Mixing	4	184	2.25	51.75
Wheeling	3	146	2.25	41.06
Heating Binder	4	192	2.25	53.98
Heating Binder	3	18	2.25	5.06
Rollerman	1	17	4.50	9.56
413 square yards, at $0.479				$197.84

Seal Coat.

		Per Sq. Yd.
Labor	$23.50	$0.056
Chips, 3 cubic yards, at $1.90	5.70	0.014
Binder, 264 gallons, at $0.118	31.15	0.076—0.64 gal. per sq. yd.
413 square yards, at $0.146	$60.35	$0.146

*Labor Mixing Tar and Asphalt on Ground.**

Foreman, 3 hours	$1.50
Laborers, 2 men, 9 hours	2.53
Laborers, 3 men, 24 hours	6.75
288 gallons, at $0.037	$10.78

* This labor included part of two days, requiring heating up twice and emptying from kettles to barrels for future use. Should be mixed as used, requiring only use of extra kettle kept hot with asphalt ready to mix.

Labor.	No.	Hours.	Rate.	
Foreman	1	6	$4.00	$3.00
Pouring	1	6	2.25	1.68
Squegee	1	6	2.25	1.68
Heating and Carrying Binder	3	19	2.25	5.34
Spreading Chips	2	12	2.25	3.37
Wheeling and Heating Chips	4	20	2.25	5.62
Rollerman	1	5	4.50	2.81
				$23.50

Mixing binder at plant, $31.56.....$0.076 per sq. yd.

Cost of this section high because work was not continuous, waiting for binder and also because of cold weather making stone harder to heat. Chips were wet and cold and required heating for seal coat.

Actual time for laying surface course, six days, or an average of 69 square yards per day.

Actual time for laying seal coat, six hours, or an average of 551 square yards per day.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Ten—24 + 50 to 27 + 97.

Bituminous Pavement Mixing Method.

Foundation Course—1½-inch crushed trap rock and screenings were spread and rolled to a finished depth of 3¾ inches.

Surface Course or Paving Mixture—The paving mixture consists of 3 parts ¾-inch trap rock, 1 part ⅜-inch trap rock chips and 6 per cent. by weight of refined tar. The binder and stone were heated on the ground and mixed by hand on mixing boards, spread and rolled with an eighteen-ton roller to a finished depth of 2¾ inches. The binder used was refined tar made up in accordance with specifications drawn up by the Office of Public Roads, U. S. Dept. of Agriculture.

Seal Coat—About .6 of a gallon to the square yard was applied, over which chips were spread and rolled.

Cost Per Square Yard.

Base Course	$0.305
Surface Course	0.868
Seal Coat	0.135
Fuel	0.063
Hauling Binder	0.008
Tar and Stone Heaters	0.003
	$1.382

Detailed Cost Per Square Yard.

Base—3¾ inches thick.

		Per Sq. Yd.
113.6 cubic yards Trap Rock at $1.65	$187.44	$0.229
11.3 cubic yards Screenings, at $1.65	18.74	$0.022
Labor		0.054
		$0.305

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Surface Course.

		Per Sq. Yd.		FIELD LABOR.	No.	Hours.	Rate.	
Labor	$308.91	$0.377		Foreman	1	52	$4.00	$26.00
¾-inch Trap Rock, 82.5 cubic yards, at $1.80	148.50	0.181		Spreading	1	20	2.25	5.60
Chips, 27.5 cubic yards, at $1.90.	52.25	0.064		Spreading	2	63	2.25	17.71
Binder, 2,016 gallons, at $0.10..	201.60	0.246	—2.46 per sq. yd.	Mixing	4	201	2.25	56.53
				Wheeling Stone	4	99	2.25	27.84
				Wheeling Stone	5	140	2.25	39.37
				Heating Stone	3	36	2.25	10.12
				Heating Stone	5	200	2.25	56.25
				Heating Tar	5	176	2.25	49.50
				Heating Tar	3	23	2.25	6.47
				Rollerman	1	24	4.50	13.50
819 square yards, at $0.868..	$711.26	$0.868		819 square yards, at $0.868				$308.91

Seal Coat.

		Per Sq. Yd.		LABOR.	No.	Hours.	Rate.	
Labor	$50.89	$0.062		Foreman	1	9	$4.00	$4.50
Chips, 6.0 cubic yards, at $1.90..	11.40	0.014		Boring	1	10	2.25	2.81
Binder, 480 gallons, at $0.10..	48.00	0.059	—.59 gals per sq. yd.	Squegee	1	10	2.25	2.81
				Heating Tar	6	54	2.25	15.18
				Carrying Tar	4	35	2.25	9.84
				Spreading Chips	1	9	2.25	2.53
				Wheeling Chips	4	31	2.25	8.72
				Rollerman	1	8	4.50	4.50
819 square yards, at $0.135.	$110.29	$0.135		819 square yards, at $0.062				$50.89

Actual time for laying surface course, six days four hours, or an average of 126 square yards per day.
Actual time for laying seal coat, on day two hours, or an average of 655 square yards per day.
Chips not heated.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Eleven—27+ 97 to 29 + 00.

Barrett Manufacturing Co.'s "Modern Pavement."

Foundation Course—1½-inch crushed trap rock was spread and rolled to a finished depth of 3 inches.

Surface Course or Paving Mixture—A sufficient quantity of sand was spread to fill the voids and laid about ½ inch in thickness on top of the foundation course, over which about 1 gallon of Tarvia X to the square yard was applied. 1½-inch crushed trap rock was then spread and lightly rolled to a depth of 3 inches. About 2 gallons of Tarvia X to the square yard was then applied by the penetration method. A layer of ¾-inch stone was spread and rolled. An eighteen-ton roller was used.

Seal Coat—About 1 gallon to the square yard was applied, over which coarse sand was spread and rolled.

Cost Per Square Yard.

Base Course	$0.305
Surface Course	0.698
Seal Coat	0.219
Hauling Binder	0.010
Tar Heater	0.003
Fuel	0.021
	$1.256

Detailed Cost Per Square Yard.

Base—3 inches thick.

		Per Sq. Yd.
33.8 cubic yards Trap Rock, at $1.65	$55.77	$0.229
3.3 cubic yards Screenings, at $1.65	5.57	0.022
Labor		0.054
		$0.305

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Surface Course.

		Per Sq. Yd.
Labor	$59.06	$0.243
1½-inch Trap Rock, 19.6 cubic yards, at $1.65	32.34	0.133
Sand, 6.5 cubic yards, at $1.21	7.86	0.032
Binder, 1st Coat, 262 gallons, at $0.095	24.89	0.102—1.08 gals. per sq. yd.
Binder, 2d Coat, 480 gallons, at $0.095	45.60	0.188—1.97 gals. per sq. yd.
243 square yards, at $0.698	$169.75	$0.698

FIELD LABOR.

First Coat.

	No.	Hours.	Rate.	
Foreman	1	6	$4.00	$3.00
Pouring	3	12	2.25	3.37
Heating Binder	2	13	2.25	3.65
Spreading Sand	10	20	2.25	5.62
Rollerman	1	2	4.50	1.12
243 square yards, at $0.069				$16.76

Second Coat.

	No.	Hours.	Rate.	
Foreman	1	16	$4.00	$8.00
Pouring	3	9	2.25	2.53
Pouring	2	16	2.25	4.50
Heating Binder	3	9	2.25	2.53
Heating Binder	2	16	2.25	4.50
Spreading 1½-inch Stone	10	20	2.25	5.62
Spreading 1½-inch Stone	10	30	2.25	8.43
Rollerman	1	11	4.50	6.19
243 square yards, at $0.174				$42.30

Seal Coat.

		Per Sq. Yd.
Labor	$17.32	$0.071
¾-inch Trap Rock, 5.0 cubic yards, at $1.80	9.00	0.037
Sand, 2.0 cubic yards, at $1.21	2.42	0.010
Screenings, 1.0 cubic yards, at $1.65	1.65	0.007
Binder, 240 gallons, at $0.095	22.80	0.094— .99 gals. per sq. yd.
243 square yards, at $0.219	$53.19	$0.219

LABOR.

	No.	Hours.	Rate.	
Foreman	1	6	$4.00	$3.00
Heating Binder	1	6	2.25	1.68
Pouring Binder	2	10	2.25	2.81
Spreading Sand	2	10	2.25	2.81
Spreading ¾-inch Stone	2	16	2.25	4.50
Spreading Screenings	3	3	2.25	0.84
Rollerman	1	3	4.50	1.68
				$17.32

Actual time for laying surface course—1st coat, six hours, or an average of 324 yards per day. 2d coat, eight hours, or an average of 243 square yards per day.

Actual time for laying seal coat, six hours, or an average of 324 square yards per day.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Twelve—29 + 00 to 31 + 00.

Bituminous Pavement Penetration Method.

Foundation Course—1½-inch crushed trap rock and sufficient screenings to fill the voids was spread and rolled to a finished depth of 3½ inches.

Surface Course or Paving Mixture—1½-inch crushed trap rock was spread and lightly rolled to a depth of 2¾ inches. From 29 + 00 to 30 + 50 about 1½ gallons of Sanford & Strains asphalt binder was applied and a layer of ¾-inch trap rock was spread and rolled. From 30 + 50 to 31 + 00, the Standard Oil Co.'s special binder was used.

Seal Coat—¾ of a gallon to the square yard was applied, over which coarse sand and chips were spread and rolled. An eighteen-ton roller was used.

Cost Per Square Yard.

Base Course	$0.329
Surface Course	0.501
Seal Coat	0.123
Hauling Binder	0.006
Tar and Stone Heaters	0.003
Fuel	0.021
	$0.983

Detailed Cost Per Square Yard.

Base—3½ inches thick.

		Per Sq. Yd.
65.7 cubic yards Trap Rock, at $1.65	$108.40	$0.229
13.1 cubic yards Screenings, at $1.65	21.68	0.046
Labor		0.054
		$0.329

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Surface Course.

		Per Sq. Yd.		FIELD LABOR.	No.	Hours.	Rate.	
Labor	$93.56	$0.198		Foreman	1	28	$4.00	$14.00
1½-inch Trap Rock, 45.9 cubic yards, at $1.65	75.73	0.161		Pouring Binder	1	16	2.25	4.50
¾-inch Trap Rock, 3.5 cubic yards, at $1.80	6.30	0.013		Heating Binder	2	38	2.25	10.68
Binder, 719 gallons, at $0.085	61.11	0.129—1.52 gals. per sq. yd.		Carrying Binder	3	34	2.25	9.56
				Spreading Top Course, 1½-inch stone	7	92	2.25	25.87
				Spreading ¾-inch Stone	1	20	2.25	5.62
				Wheeling Stone	2	21	2.25	5.90
				Heating Stone	3	32	2.25	9.00
				Rollerman	1	15	4.50	8.43
472 square yards, at $0.501	$237.70	$0.501		472 square yards, at $0.198				$93.56

Seal Coat.

		Per Sq. Yd.		LABOR.	No.	Hours.	Rate.	
Labor	$21.31	$0.045		Foreman	1	5	$4.00	$2.50
Chips, 3.5 cubic yards, at $1.90	6.65	0.014		Pouring Binder	1	5	2.25	1.40
Binder, 353 gallons, at $0.085	30.01	0.064— .75 gal. per sq. yd.		Carrying Binder	3	12	2.25	3.37
				Heating Binder	2	13	2.25	3.65
				Spreading Chips	1	7	2.25	1.96
				Wheeling Chips	2	9	2.25	2.53
				Heating Chips	2	11	2.25	3.09
				Rollerman	1	5	4.50	2.81
472 square yards, at $0.123	$57.97	$0.123						$21.31

Actual time for laying surface course (including top course), 3½ days, or an average of 135 square yards per day. ¾-inch stone required heating. Owing to lack of binder, work was deferred three times, which of course added to cost. Actual time for laying seal coat, five hours, or an average of 755 square yards per day. Chips required heating.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

SECTION THIRTEEN—31 + 00 TO 33 + 00.

Hassam Concrete Pavement.

1½-inch trap rock (crushed) was laid and rolled with an eighteen-ton roller to a finished depth of six inches. Sand and cement were mixed in proportions of 1¾ sand to 1 of cement and forced into the voids of the stone by means of a special pressure machine used by the Hassam Paving Company.

		Per Sq. Yd.
Labor	$110.40	$0.234
1½-inch Trap (total) 111.6 cubic yards, at $1.65	184.14	0.390
Sand, 33.0 cubic yards, at $1.21	39.93	0.085
Cement, 535 bags, at $1.35 per barrel	180.56	0.382
Hauling Sand, Cement and Tools—		
6 teams, 80 hours, at $0.625 per hour	50.00	0.118
2 men, 20 hours, at $0.28⅛ per hour	5.62	
		$1.209

FIELD LABOR.	No.	Hours.	Rate.	
Foreman	1	20	$4.00	$10.00
Spreading 1½-inch Stone.	8	64	2.25	18.00
	12	48	2.25	13.50
	16	128	2.25	36.00
Filling bags with sand	3	48	2.25	13.50
Filling bags with sand	3	21	2.25	5.90
Mixer & Roller Engineer.	1	24	4.50	13.50
472 square yards, at $0.234				$110.40

Total cost per square yard, $1.209.

Actual time for laying pavement, two days four hours, an average of 189 square yards per day.

The cost of hauling could be considerably reduced.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Fourteen—33+ 00 to 34 + 50.

Water Bound Macadam.

1½-inch crushed trap rock and sufficient screenings to fill the voids were spread, sprinkled and rolled with an eighteen-ton roller to a finished depth of 6 inches.

Cost Per Square Yard.

		Per Sq. Yd.	Field Labor.	No.	Hours.	Rate.	
Labor	$107.11	$0.303	Foreman	1	37	$4.00	$18.50
1½-inch Trap Rock (total), 83.7 cubic yards, at $1.65	138.10	0.390	Spreading	7	254	2.25	71.43
Screenings, 16.7 cubic yards, at $1.65	27.55	0.078	Sprinkling Team	1	14	5.00	8.75
			Rollerman	1	15	4.50	8.43
354 square yards, at $0.771	$272.76	$0.771					$107.11

Total cost per square yard $0.771.

Macadam spread in two courses. Actual time in laying, four days four hours, an average of 79 square yards per day.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Fifteen—34 + 50 to 36 + 25.

Bituminous Pavement Penetration Method.

Foundation Course—1½-inch crushed trap rock and screenings were spread and rolled to a finished depth of 3½ inches.

Surface Course or Paving Mixture—1½-inch crushed trap rock was spread and lightly rolled to a depth of 2½ inches. 2.3 gallons to the square yard of Tarvia was then applied, after which a layer of chips was spread and rolled.

Seal Coat—About ¾ of a gallon of Tarvia to the square yard was applied, over which chips was spread and rolled. An eighteen-ton roller was used.

Cost Per Square Yard.

Base Course	$0.305
Surface Course and Seal Coat	0.735
Fuel	0.021
Hauling Binder	0.008
Tar Heater	0.002
	$1.071

Detailed Cost Per Square Yard.

Base—3½ inches thick.

		Per Sq. Yd.
57.4 cubic yards Trap Rock, at $1.65	$94.71	$0.229
5.7 cubic yards Screenings, at $1.65	9.47	0.022
Labor		0.054
		$0.305

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SURFACE COURSE AND SEAL COAT COMBINED.

		Per Sq. Yd.		LABOR.	No.	Hours.	Rate.	
Labor	$100.77	$0.244		Foreman	1	48	$4.00	$24.00
1½-inch Trap Rock, 40.2 cubic yards, at $1.65	66.33	0.161		Pouring and Carrying Tar	3	106	2.25	29.81
Chips, 8.0 cubic yards, at $1.65	13.20	0.032		Heating Tar	1	11	2.25	3.08
Binder, 1,296 gallons, at $0.095	123.12	0.298	—3.14 gals. per sq. yds.	Heating Tar	2	48	2.25	13.50
				Spreading 1½-inch Stone	15	60	2.25	16.88
				Spreading Chips	1	16	2.25	4.50
				Rollerman	1	16	4.50	9.00
413 square yards, at $0.735	$303.42	$0.735						$100.77

Cost of first coat of binder and seal coat not separated. Flush coat equal to about .75 gallons per square yard.
Actual time of laying, five days, or an average of 80 square yards per day. (Four full days and two part days.)
Length of time due to poor supervision.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Sixteen—36 + 25 to + 75.

Bituminous Pavement Penetration Method.

Foundation Course—1½-inch crushed trap rock and screenings were spread and rolled to a finished depth of 3½ inches.

Surface Course or Paving Mixture—1½-inch crushed trap rock was spread and slightly rolled to a depth of 3 inches. 1½ gallons to the square yard of Bermudez road asphalt was then applied, after which a layer of chips was spread and rolled.

Seal Coat—½ gallon to the square yard of Bermudez was applied, over which chips was spread and rolled. An eighteen-ton roller was used.

Cost Per Square Yard.

Base Course	$0.305
Surface Course	0.519
Seal Coat	0.123
Hauling Binder	0.005
Tar Heaters	0.002
Fuel	0.021
	$0.975

Detailed Cost Per Square Yard.

Base—3½ inches thick.

		Per Sq. Yd.
49.2 cubic yards Trap Rock, at $1.65	$81.18	$0.229
4.9 cubic yards Screenings, at $1.65	8.12	0.022
Labor		0.054
		$0.305

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Surface Course.

		Per Sq. Yd.		FIELD LABOR.	No.	Hours.	Rate.	
Labor	$45.14	$0.128		Foreman	1	11	$4.00	$5.50
1½-inch Trap Rock, 34.5 cubic yards, at $1.65	56.92	0.161		Pouring Asphalt	2	18	2.25	5.06
Chips, 5.0 cubic yards, at $1.90	9.50	0.027		Heating Asphalt	2	19	2.25	5.34
Binder, 550 gallons, at $1.31	72.05	0.203	—1.55 gals. per sq. yd.	Carrying Asphalt	2	18	2.25	5.06
354 square yards, at $0.519	$183.61	$0.519		Spreading 1½-inch Trap Rock	5	36	2.25	10.12
				Spreading Chips	2	18	2.25	5.06
				Rollerman	1	16	4.50	9.00
								$45.14

Seal Coat.

		Per Sq. Yd.		LABOR.	No.	Hours.	Rate.	
Labor	$11.53	$0.032		Foreman	1	4	$4.00	$2.00
Chips, 5.0 cubic yards, at $1.90	9.50	0.027		Pouring Asphalt	2	6	2.25	1.68
Binder, 173 gallons, at $0.131.	22.66	0.064	—0.49 gal. per sq. yd.	Squegee	1	3	2.25	0.84
354 square yards, at $0.123	$43.69	$0.123		Heating Asphalt	1	3	2.25	0.84
				Carrying Asphalt	2	6	2.25	1.68
				Spreading Chips	2	6	2.25	1.68
				Spreading Chips	4	4	2.25	1.12
				Rollerman	1	3	4.50	1.69
								$11.53

Nothing except binder heated on ground, chips delivered hot from plant and remained warm until finish of job.
Actual time for laying surface course, one day, three hours, or an average of 257 square yards per day.
Actual time for laying seal coat, four hours, or an average of 708 square yards per day.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Seventeen—37 + 75 to 39 + 22.

Bituminous Pavement Penetration Method.

Surface and Base Course Spread in One Course—1½-inch crushed trap rock was spread and rolled to a depth of 6 inches. 1⅓ gallons to the square yard of Standard Oil Co.'s Binder "B" was then applied, over which a layer of ¾-inch trap rock was spread and rolled.

Seal Coat—1.1 gallon to the square yard of Binder "B" was applied, after which chips was spread and rolled. An eighteen-ton roller was used.

Cost Per Square Yard.

Surface and Base Course	$0.648
Seal Coat	0.177
Fuel	0.021
Hauling Binder	0.006
Tar Heater	0.001
	$0.853

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Detailed Cost Per Square Yard.

Surface and Base Course.

		Per Sq. Yd.		FIELD LABOR.	No.	Hours.	Rate.	
Labor	$41.90	$0.121		Foreman	1	18	$4.00	$9.00
1½-inch Trap Rock, 82.0 cubic yards, at $1.65	135.30	0.390		Pouring and Carrying Oil.	3	48	2.25	13.50
¾-inch Trap Rock, 5.0 cubic yards, at $1.80	9.00	0.026		Heating Oil	2	25	2.25	7.03
Binder, 480 gallons, at $0.08	38.40	0.111	1.38 gals per sq. yd.	Spreading 1½-inch Trap Rock	10	20	2.25	5.62
				Spreading ¾-inch Trap Rock	2	16	2.25	4.50
				Rollerman	1	4	4.50	2.25
347 square yards, at $0.648.	$224.60	$0.648		347 square yards, at $0.121				$41.90

Seal Coat.

		Per Sq. Yd.		LABOR.	No.	Hours.	Rate.	
Labor	$25.12	$0.072		Foreman	1	12	$4.00	$6.00
Chips, 3.0 cubic yards, at $1.90.	5.70	0.017		Pouring and Carrying Oil	2	24	2.25	6.75
Binder, 384 gallons, at $0.08	30.70	0.088	1.11 gals. per sq. yd.	Heating Oil	1	13	2.25	3.65
				Spreading Chips	2	23	2.25	6.47
				Rollerman	1	4	4.50	2.25
347 square yards, at $0.177.	$61.54	$0.177						$25.12

Actual time for laying surface course (excluding base course), 2¼ days, or an average of 154 square yards per day.
Actual time for laying seal coat, 1½ days, or an average of 231 square yards per day.
Nothing but binder heated.
1½-inch trap rock spread in one course without screenings.

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WHITE PLAINS AVENUE EXPERIMENTAL PAVEMENTS.

Section Eighteen—39 + 22 to 41 + 20.

Standard Oil Co.'s Sand Surface Method.

Application of Oil and Sand—This was an old strip of waer-bound macadam which was swept, after which ¾ gallon to the square yard of Standard Oil Co.'s Binder A was applied, over which sand was spread about one inch thick and lightly rolled.

Cost Per Square Yard.

Sand Course	$0.178
Hauling Binder	0.002
Tar Heater	0.001
Fuel	0.021
	$0.202

Sand Course.

		Per Sq. Yd.		Field Labor.	No.	Hours.	Rate.	
Labor	$40.45	$0.086		Foreman	1	14	$4.00	$7.00
Sand, 10 cubic yards, at $1.21	12.10	0.026		Cleaning Macadam	3	24	2.25	6.75
Binder, 384 gallons, at 0.08	30.72	0.066—.82 gals. per sq. yd.		Pouring and Carrying Binder	4	40	2.25	11.25
				Heating Binder	2	20	2.25	5.62
				Spreading Sand	3	21	2.25	5.90
				Tamping	1	2	2.25	0.56
				Rollerman	1	6	4.50	3.37
467 square yards, at $0.178	$83.27	$0.178		467 square yards, at $0.086				$40.45

Actual time for laying sand course 2½ days (gang time), or an average of 187 square yards per day, including cleaning and brooming old macadam.

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Cost of Base Course, Fuel, Hauling Binder, Tar Kettles, Stone Heaters, etc.

3½-inch Macadam Base.

		Per Sq. Yd.
379.5 cubic yards 1½-inch Trap Rock, at $1.65	$626.17	$0.229
37.9 cubic yards Screenings, at $1.65	62.61	0.022
Labor		0.054
2733 square yards		$0.305

3½-inch Macadam Base.

		Per Sq. Yd.
321.4 cubic yards 1½-inch Trap Rock, at $1.65	$530.31	$0.229
Labor		0.054
2316 square yards		$0.283

4¾-inch Concrete Base—Williams' Process.

		Per Sq. Yd.
59 cubic yards 1½-inch Trap Rock, at $1.65.	$97.35	$0.275
Labor, spreading 1½-inch Stone	.....	0.054
Screenings, 9.0 cubic yards, at $1.65	14.85	0.042
Cement, 20¼ barrels, at $1.35	27.34	0.077
Labor, mixing Cement, Screenings and Rolling, etc.	19.96	0.056
354 square yards		$0.504

3½-inch Macadam Base.

		Per Sq. Yd.
221.3 cubic yards 1½-inch Trap Rock, at $1.65	$365.14	$0.229
44.2 cubic yards Screenings, at $1.65	73.02	0.046
Labor		0.054
1592 square yards		$0.329

4½-inch Macadam Base.

		Per Sq. Yd.
129.9 cubic yards 1½-inch Trap Rock, at $1.65	$214.33	$0.299
13.0 cubic yards Screenings, at $1.65	21.43	0.029
Labor		0.054
718 square yards		$0.382

Spreading Base Course.

Foreman, 98 hours, at $0.50	$49.00
Laborers, 1,149 hours, at $0.28⅛	323.15
Rollerman, 82 hours, at $0.56¼	46.12
7,713 square yards, at $0.054	$418.27

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FUEL.

41 cords at $6.50..... $266.50
$0.048 per square yard on 5,568 square yards.

Estimated $0.021 per square yard for penetration and mixing with cold stone.

Estimated $0.063 per square yard for mixing with hot stone.

The heating surface required to heat the stone was twice the area of that required to heat tar and asphalt, therefore the mixing jobs when stone was heated required three times the amount of wood than was used on penetration or cold stone sections when binder only was heated.

Hauling Binder.

12,000 gallons cost $93.70.....$0.0078 per gallon.
Should cost for same haul
5 loads=500 gals. x 5=2,500 gals per day, at $6.50..$0.0026 per gal.

Tar Kettles and Stone Heaters.

Tar kettles cost about $100; life ten years.
Interest 4 per cent. for 10 years, plus Sinking Fund $8.006 per year for ten years = $120.06.
Total cost $120.06 for 10 years = $12.006 per year.
120 working days = 10c per day.
Stone heaters of flat plates cost about $15.00.
Life 10 years = Interest 4 per cent. for 10 years.
Plus Sinking Fund $1.20 per year for 10 years = $18.00.
Total cost $1.80 per year.
120 working days = 1½c per day.

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Pavement.	Date.	Temperature. 9	12	3	Weather.	Date Completed.	Temperature. 9	12	3	Weather.
Barber Asphalt.....	Sept. 29, 1910	62	65	67	Clear....	Sept. 29, 1910	62	65	67	Clear....
Bronx Asphalt 55.....	Sept. 30, 1910	62	65	67	Hazy....	Oct. 1, 1910	66	70	..	Clear....
Bronx Asphalt.....	Oct. 14, 1910	60	68	69	Fair.....	Oct. 15, 1910	61	63	..	Cloudy...
Standard Oil Mixing.....	Nov. 9, 1910	39	45	46	Cloudy...					
	Nov. 10, 1910	48	54	55	Clear....					
	Nov. 11, 1910	44	48	43	Cloudy...					
	Nov. 12, 1910	35	37	..	Cloudy...					
	Nov. 14, 1910	38	44	43	Cloudy...	Nov. 15, 1910	33	39	40	Cloudy...
Texas Mixing.....	Oct. 5, 1910	71	74	76	Cloudy...					
	Oct. 6, 1910	72	76	79	Clear....					
	Oct. 8, 1910	54	55	..	Cloudy...					
	Oct. 10, 1910	56	59	52	Clear....					
	Oct. 11, 1910	59	66	69	Clear....					
	Oct. 13, 1910	48	52	55	Clear....					
	Oct. 14, 1910	60	68	69	Fair.....	Oct. 15, 1910	61	63	..	Cloudy...
Amiesite	Nov. 7, 1910	34	40	43	Clear....					
	Nov. 9, 1910	39	45	46	Cloudy...					
	Nov. 10, 1910	48	54	55	Clear....	Nov. 11, 1910	44	48	43	Cloudy...
Sicilian Asphalt.....	Oct. 19, 1910	59	65	68	Clear....	Oct. 21, 1910	55	57	59	Cloudy...
Tarvia Mixing	Oct. 26, 1910	49	54	56	Clear....					
	Oct. 27, 1910	58	65	67	Cloudy...					
	Oct. 28, 1910	54	55	56	Clear....					
	Oct. 29, 1910	44	48	..	Clear....					
	Oct. 31, 1910	40	49	53	Clear....	Nov. 1, 1910	44	53	56	Clear....
(Flush Coat).....	Nov. 10, 1910	48	54	55	Clear....	Nov. 11, 1910	44	48	43	Cloudy...
Tar and Asphalt Mixing.....	Oct. 26, 1910	49	54	56	Clear....					
	Oct. 27, 1910	58	65	67	Cloudy...					
	Oct. 31, 1910	40	49	53	Clear....					
	Nov. 1, 1910	44	53	56	Clear....					
	Nov. 2, 1910	52	57	60	Cloudy...					

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Pavement.	Date.	Temperature. 9	12	3	Weather.	Date Completed.	Temperature. 9	12	3	Weather.
Tar and Asphalt Mixing.....	Nov. 7, 1910	34	40	43	Clear....					
	Nov. 9, 1910	39	45	46	Overcast.	Nov. 10, 1910	48	54	55	Clear....
U. S. Tar.....	Oct. 21, 1910	55	57	59	Cloudy...					
	Oct. 22, 1910	52	53	..	Rain.....					
	Oct. 24, 1910	52	54	56	Clear....					
	Oct. 25, 1910	55	60	60	Cloudy...					
	Oct. 26, 1910	49	54	56	Clear....					
	Oct. 27, 1910	58	65	67	Cloudy...					
	Oct. 28, 1910	54	55	56	Clear....					
Barrett Mfg. Co. "Modern Pavement".....	Oct. 29, 1910	44	48	..	Clear....	Oct. 31, 1910	40	49	53	Clear....
	Oct. 19, 1910	59	65	68	Clear....					
	Oct. 21, 1910	55	57	59	Cloudy...					
	Oct. 22, 1910	52	53	..	Rain.....					
	Oct. 24, 1910	52	54	56	Clear....	Oct. 25, 1910	55	60	60	Cloudy...
Section 12. Asphalt Binder (Penetration)	Nov. 14, 1910	38	44	43	Cloudy...					
	Nov. 15, 1910	33	39	40	Cloudy...					
	Nov. 17, 1910	38	40	42	Clear....					
	Nov. 18, 1910	38	44	40	Clear....	Nov. 22, 1910	37	42	46	Overcast.
Hassam Paving Co.....	Oct. 13, 1910	48	52	55	Clear....					
	Oct. 14, 1910	60	68	69	Clear....	Oct. 15, 1910	61	63	..	Cloudy...
Water Bound Macadam.....	Oct. 18, 1910	59	65	66	Clear....					
	Oct. 19, 1910	59	65	68	Clear....					
	Oct. 24, 1910	52	54	56	Clear....					
	Oct. 28, 1910	54	55	56	Clear....					
	Oct. 29, 1910	44	48	..	Clear...	Nov. 19, 1910	36	39	..	Clear....
Tarvia Penetration.....	Oct. 13, 1910	48	52	55	Clear....					
	Oct. 14, 1910	60	68	69	Fair.....					
	Oct. 15, 1910	61	63	..	Cloudy...					
	Oct. 17, 1910	60	65	66	Cloudy...					
	Oct. 18, 1910	59	65	66	Clear....	Oct. 19, 1910	59	65	68	Clear....

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Pavement.	Date.	Temperature. 9	12	3	Weather.	Date Completed.	Temperature. 9	12	3	Weather.
Barber Penetration.....	Oct. 26, 1910	49	54	56	Clear....					
	Oct. 27, 1910	58	65	67	Cloudy...	Oct. 28, 1910	54	55	56	Clear....
Standard Oil Penetration.....	Oct. 18, 1910	59	65	66	Clear....					
	Oct. 19, 1910	59	65	68	Clear....					
	Oct. 21, 1910	55	57	59	Cloudy...					
	Oct. 24, 1910	52	54	56	Clear....	Oct. 25, 1910	55	60	60	Cloudy...
Standard Oil Sand.....	Oct. 18, 1910	59	65	66	Clear....					
	Oct. 19, 1910	59	65	68	Clear....	Oct. 21, 1910	55	57	59	Cloudy...

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TRAFFIC CENSUS.

White Plains Road Experimental Roadway.—5 a. m. to 9 p. m.

	January 1911.				
	Fri. 6th	Sat. 7th	Sun. 8th	Mon. 9th	Total
Horse without vehicle	...	1	4	2	7
Horse vehicle, light	15	36	37	34	122
Horse vehicle, heavy	48	51	5	48	152
Two horse vehicle, light	5	8	3	6	22
Two horse vehicle, heavy	38	59	...	45	142
Three horse vehicle	1	...	...	...	1
Four horse vehicle	4	2	...	...	6
Motorcycles	...	...	8	1	9
Two passenger car	2	5	11	3	21
Four and five passenger car	12	27	51	21	111
Six and seven passenger car	9	12	34	9	64
Freight truck, omnibus, etc.	17	21	...	18	56
Traction engine	...	...	...	...	...
Two traction engine	...	...	...	...	...
Miscellaneous heavy traffic	...	...	...	...	...
Totals	151	222	153	187	713

	March, 1911.				
	Sat. 11th	Sun. 12th	Mon. 13th	Tues. 14th	Total
Horse without vehicle	8	2	2	1	13
Horse vehicle, light	52	35	43	51	181
Horse vehicle, heavy	73	7	57	64	201
Two horse vehicle, light	14	4	7	9	34
Two horse vehicle, heavy	64	2	65	55	186
Three horse vehicle	1	...	1	1	3
Four horse vehicle	...	...	...	...	...
Motorcycles	7	7	1	2	17
Two passenger car	9	12	13	11	45
Four and five passenger car	61	79	48	54	242
Six and seven passenger car	54	56	24	17	151
Freight truck, omnibus, etc.	32	2	30	29	93
Traction engine	...	...	...	2	2
Two traction engine	...	...	...	...	...
Miscellaneous heavy traffic	...	...	1	...	1
Totals	375	206	292	296	1169

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Sample form used for Traffic observation on White Plains Road.

TRAFFIC CENSUS.

White Plains Road Experimental Roadway.—March 11, 1911.

	5–6 A. M.	6–7 A. M.	7–8 A. M.	8–9 A. M.	9–10 A. M.	10–11 A. M.	11–12 A. M.	12–1 P. M.	1–2 P. M.	2–3 P. M.	3–4 P. M.	4–5 P. M.	5–6 P. M.	6–7 P. M.	7–8 P. M.	8–9 P. M.	Total
Horse without vehicle	...	...	...	1	...	1	...	...	...	...	3	3	...	...	...	...	8
Horse vehicle, light	...	...	1	11	6	3	5	4	2	2	4	6	5	1	2	...	52
Horse vehicle, heavy	...	...	2	4	4	3	7	5	8	11	5	6	11	4	3	...	73
Two horse vehicle, light	...	6	3	...	...	...	...	...	...	3	1	...	...	1	...	...	14
Two horse vehicle, heavy	...	...	1	9	9	5	5	2	7	6	3	5	10	1	...	1	64
Three horse vehicle	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	1
Four horse vehicle	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Motorcycles	...	...	...	...	...	...	1	...	...	2	2	1	1	...	...	...	7
Two passenger car	...	...	...	1	...	1	2	...	...	...	1	...	3	1	...	...	9
Four and five passenger car	...	...	...	2	3	2	6	3	8	8	8	8	6	3	3	1	61
Six and seven passenger car	...	...	1	2	3	3	3	1	2	1	9	11	7	5	3	3	54
Freight truck, omnibus, etc.	...	4	1	2	3	1	3	1	5	4	4	2	1	1	...	...	32
Traction engine	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Two traction engine	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Miscellaneous heavy traffic	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Totals	...	10	9	32	28	19	32	16	32	37	40	43	45	16	11	5	375

.....Inspector 5 A. M. to 1 P. M. .....Inspector. 1 P. M. to 9 P. M.

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SECTION ONE—White Plains Road Experimental Pavement. Bermudez Asphalt and Gravel Mixing Method. Completed.

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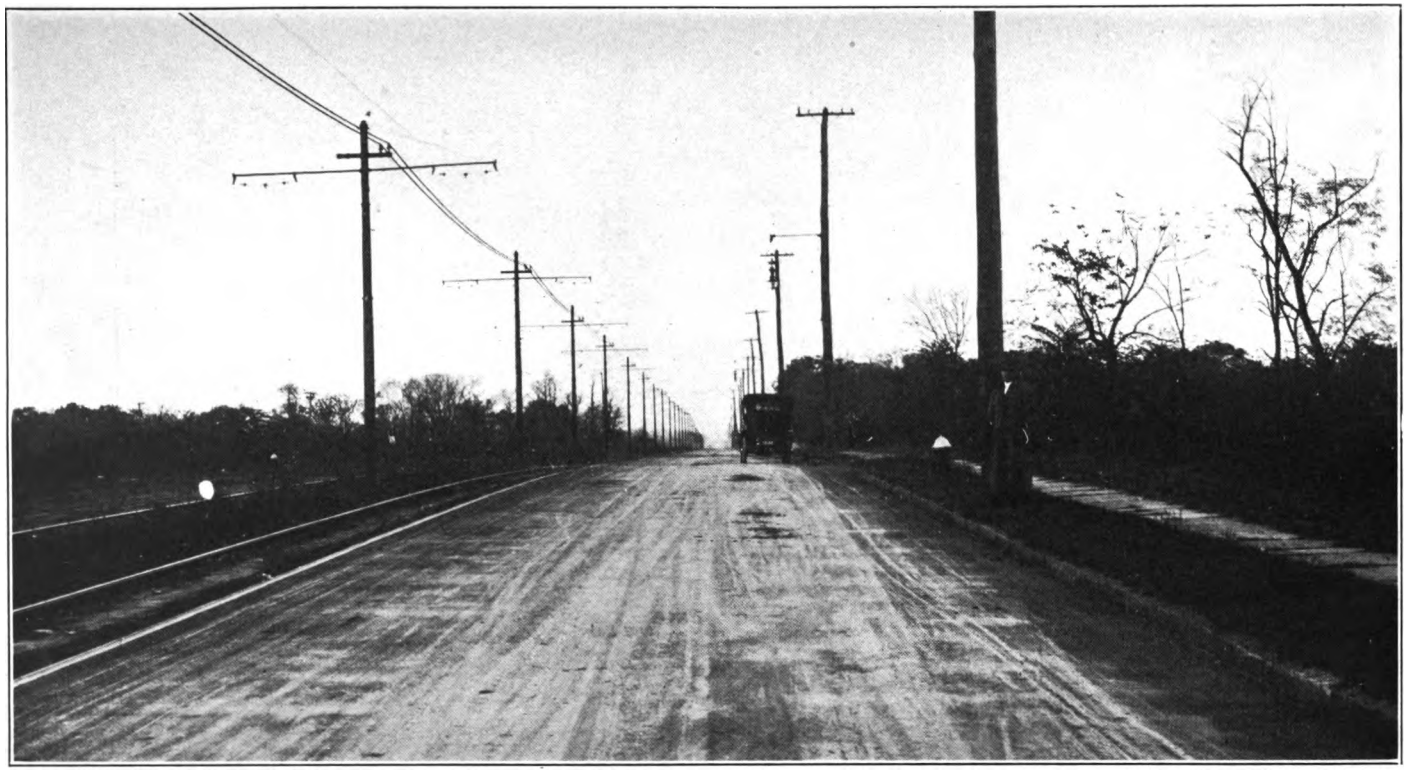

SECTION TWO—White Plains Road Experimental Pavement. Bronx Specifications, Asphalt 55 Penetration Mixing Method. Completed.

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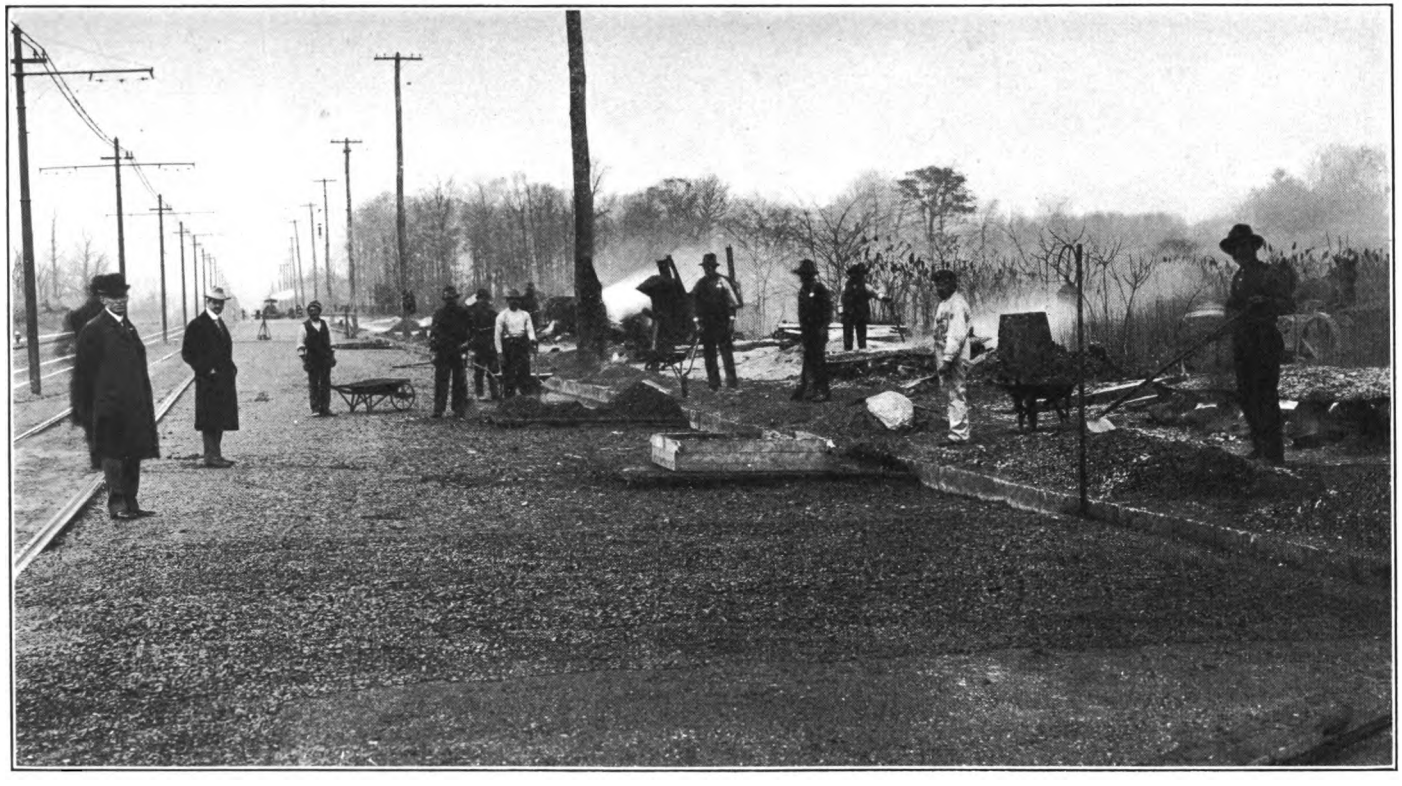

SECTION FOUR—White Plains Road Experimental Pavement. Showing Mixing Boards, Heaters, etc., Used for Standard Oil Mixing Method.

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SECTION FOUR—White Plains Road Experimental Pavement. Standard Oil Mixing Method. Completed.

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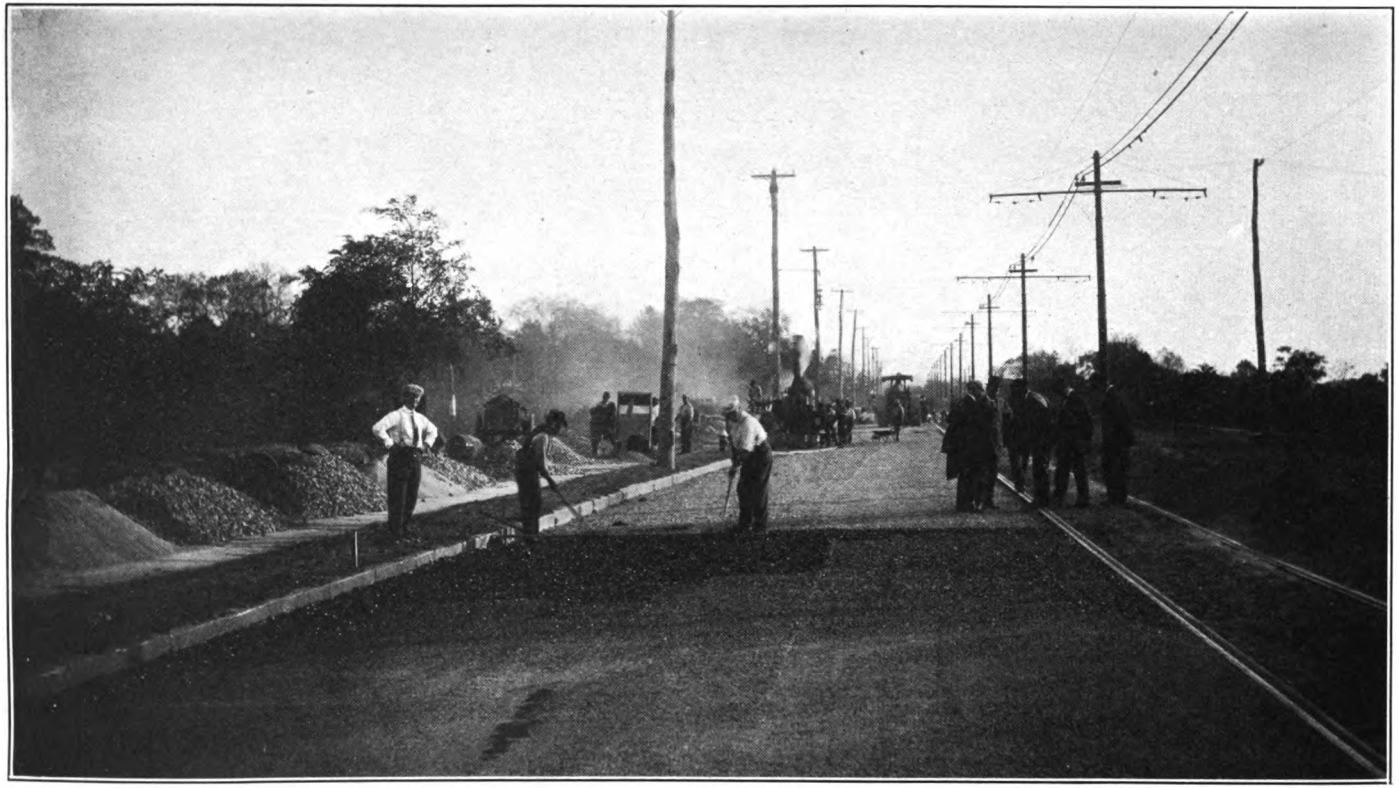

SECTION FIVE—White Plains Road Experimental Pavement. Spreading Texas Macadam Binder Mixture.

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SECTION FIVE—White Plains Road Experimental Pavement. Mixer Used for Texas Macadam Binder and Cold Stone.

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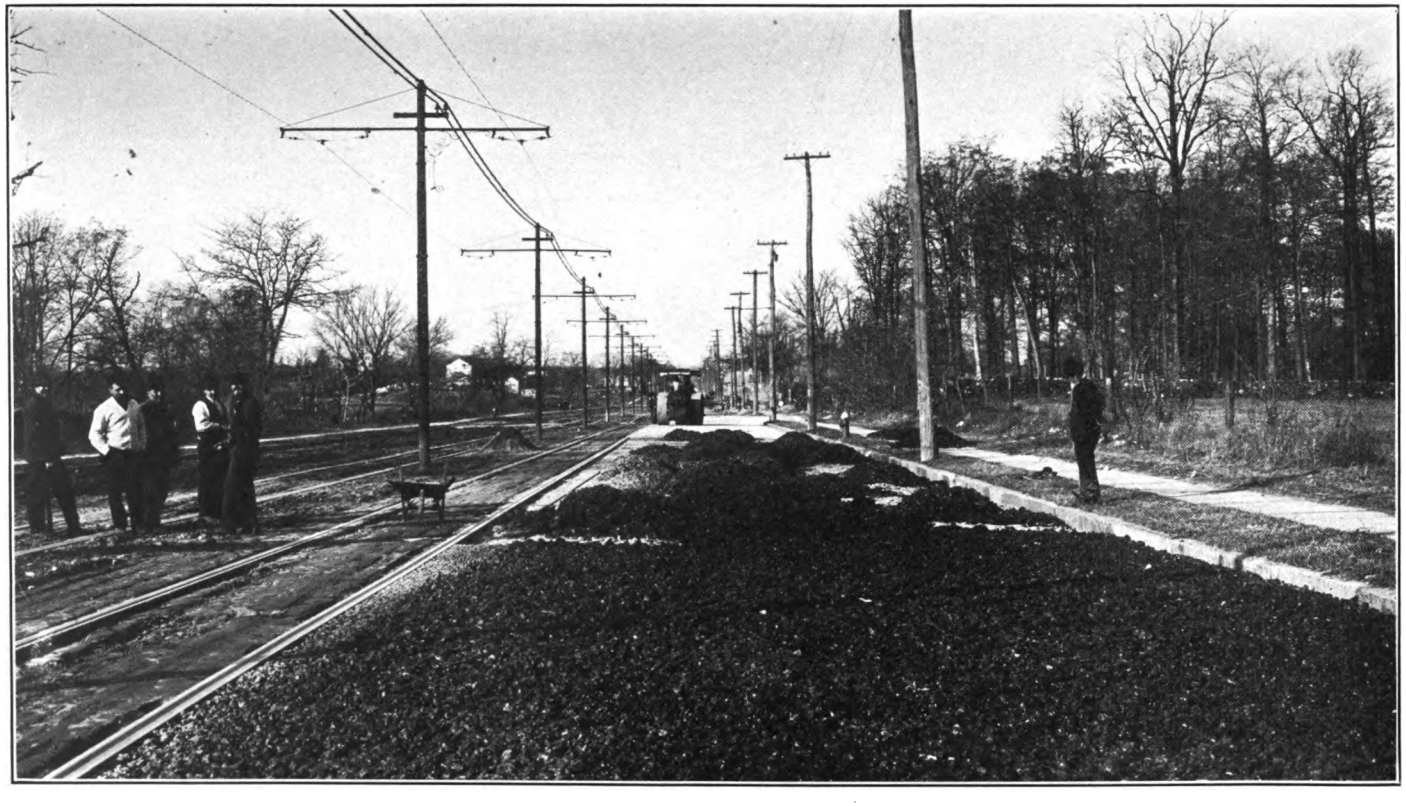

SECTION SIX—White Plains Road Experimental Pavement. Amiesite Partially Spread.

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SECTION SIX—White Plains Road Experimental Pavement. Amiesite Top Course Rolled and Unrolled.

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SECTION SEVEN—White Plains Road Experimental Pavement. Sicilian Asphalt Company's Asphalto.

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SECTION EIGHT—White Plains Road Experimental Pavement. Spreading Tarvia X Mixture.

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SECTION EIGHT—White Plains Road Experimental Pavement. Tarvia X Mixing Method. Completed.

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SECTION NINE—White Plains Road Experimental Pavement. Tar and Asphalt Mixing Method. Completed.

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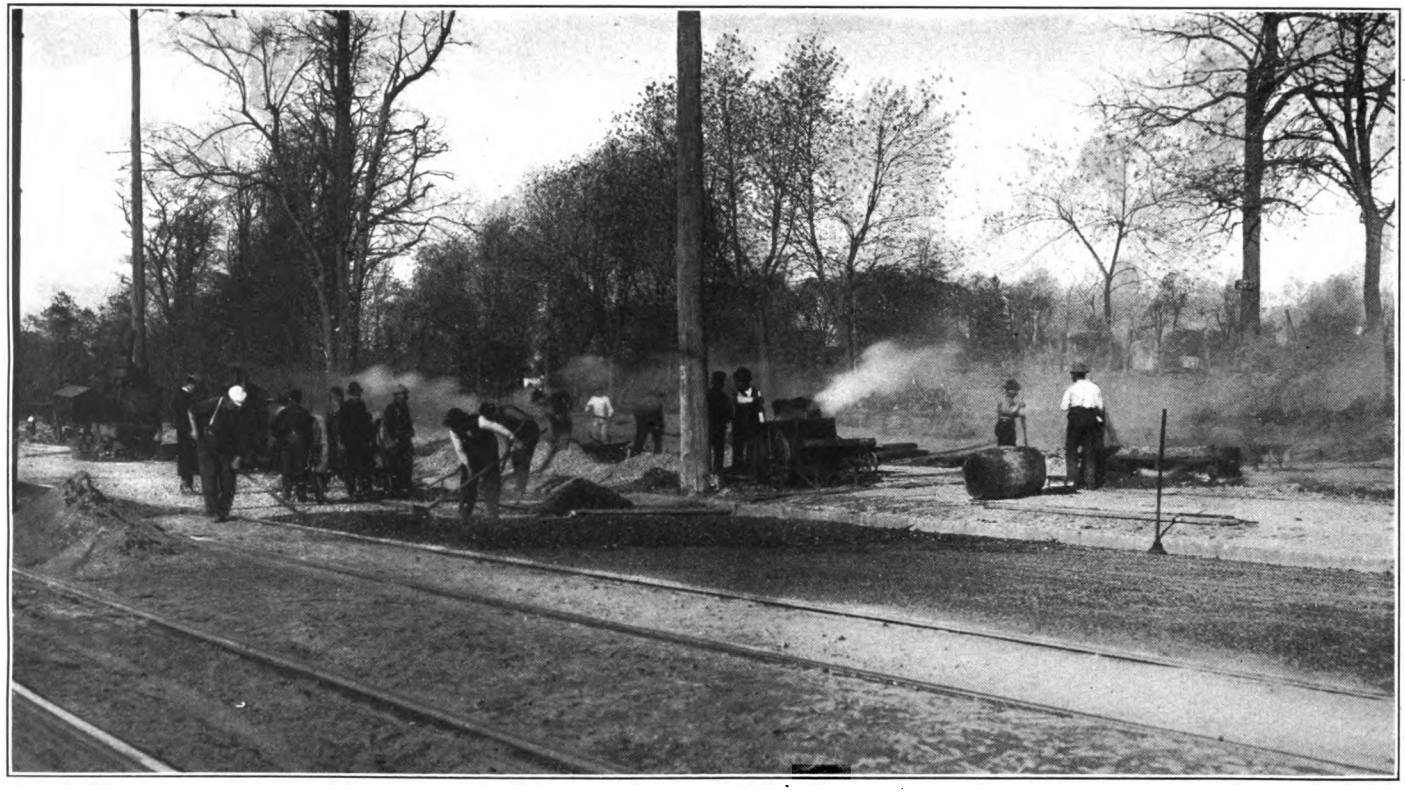

SECTION TEN—White Plains Road Experimental Pavement. Mixing and Spreading U. S. Tar Mixture.

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SECTION TEN—White Plains Road Experimental Pavement. U. S. Tar Mixing Method, Applying Seal Coat.

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SECTION TEN—White Plains Road Experimental Pavement. U. S. Tar Mixing Method. Completed.

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SECTION ELEVEN—White Plains Road Experimental Pavement. Modern Pavement, First Course, Pouring Tarvia X on Sand.

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SECTION ELEVEN—White Plains Road Experimental Pavement. Modern Pavement, Second Course Showing 1½-inch Stone Spread Over Sand and Tarvia X.

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SECTION ELEVEN—White Plains Road Experimental Pavement. Modern Pavement. Completed.

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SECTION TWELVE—White Plains Road Experimental Pavement. Asphalt Binder Penetration Method. Completed.

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SECTION THIRTEEN—White Plains Road Experimental Pavement. Hassam Concrete Pavement. Completed.

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SECTION FOURTEEN—White Plains Road Experimental Pavement. Water Bound Macadam. Completed.

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White Plains Road Experimental Pavement. Method Used for Heating Binders.

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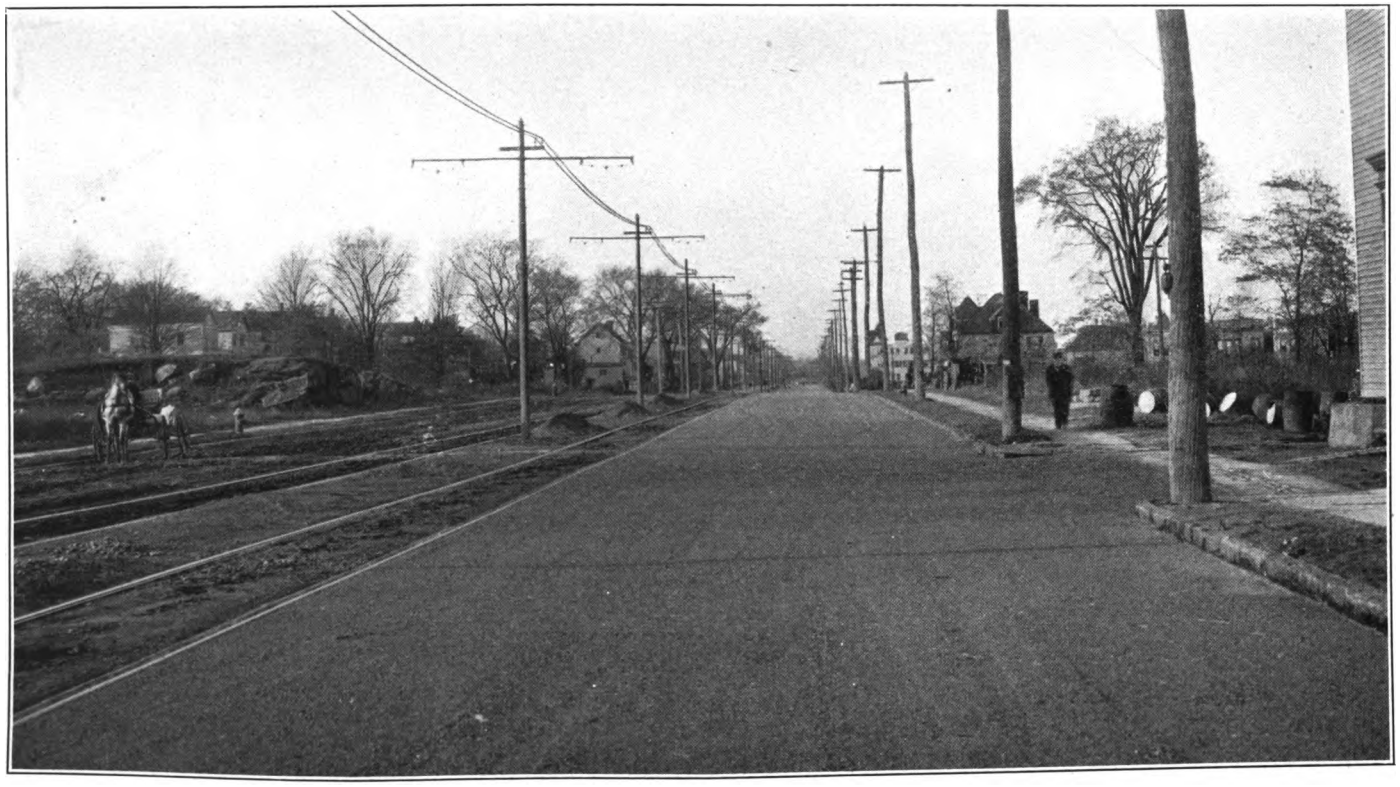

SECTION FIFTEEN—White Plains Road Experimental Pavement. Tarvia X Penetration Method. Completed.

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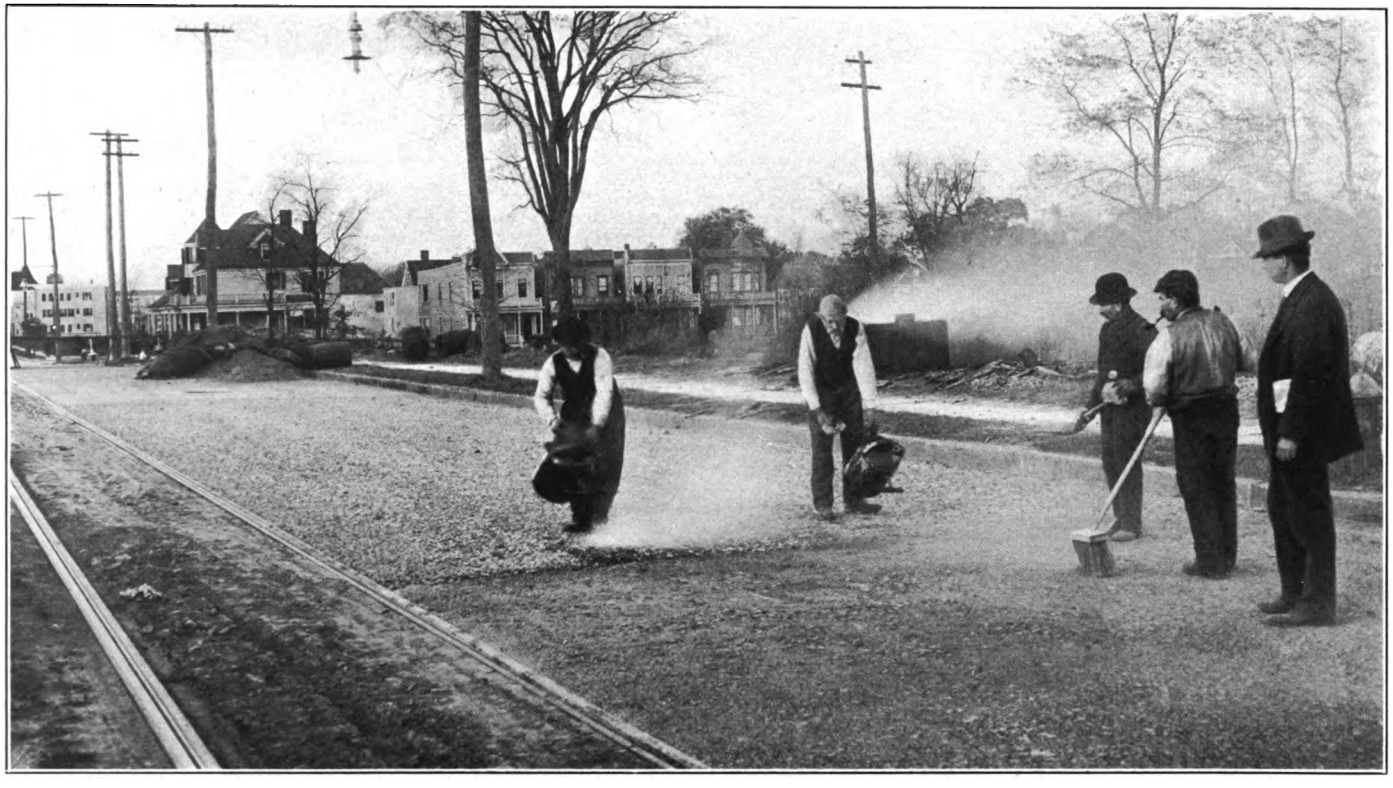

SECTION SIXTEEN—White Plains Road Experimental Pavement. Bermudez Road Asphalt Penetration Method, Pouring First Coat.

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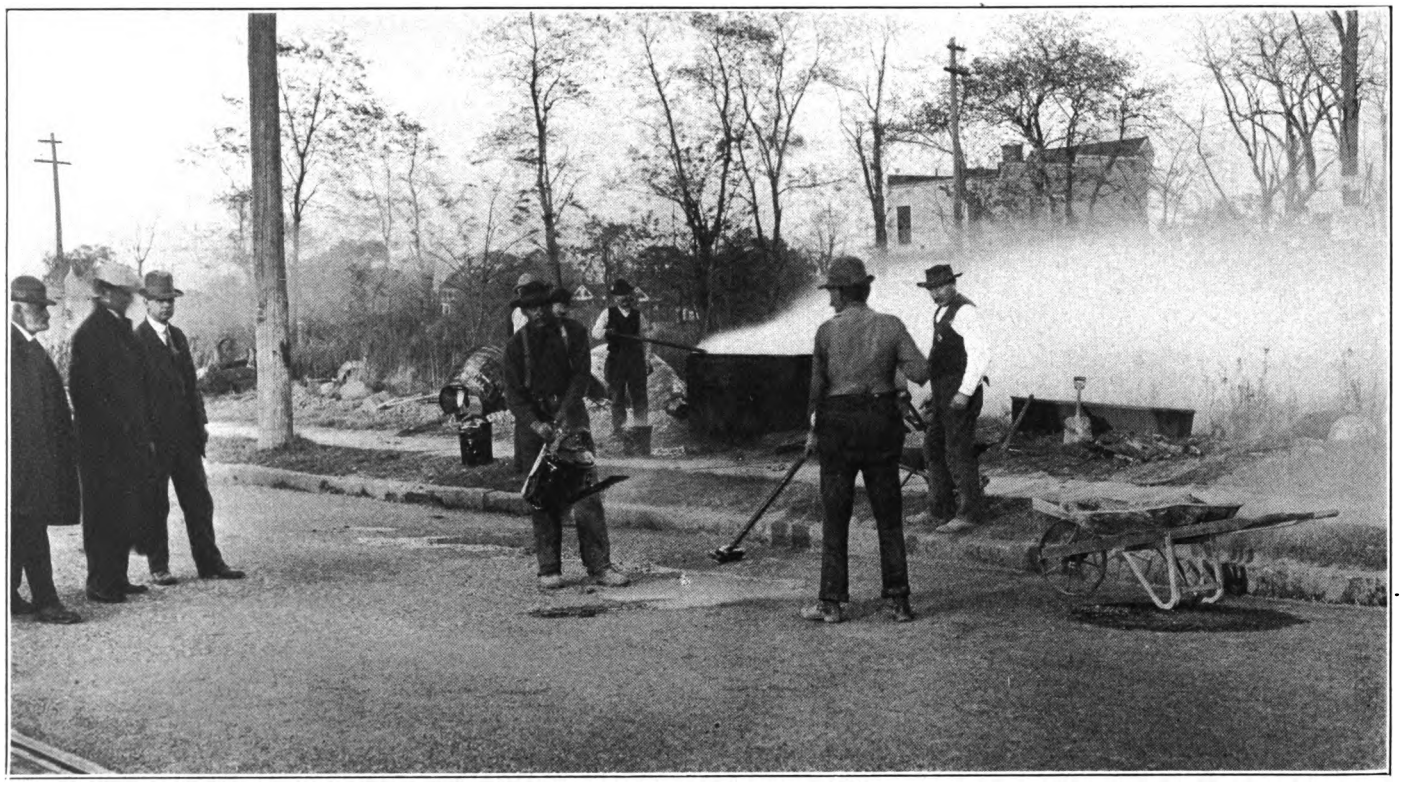

SECTION SIXTEEN—White Plains Road Experimental Pavement. Bermudez Road Asphalt Penetration Method, Pouring Seal Coat.

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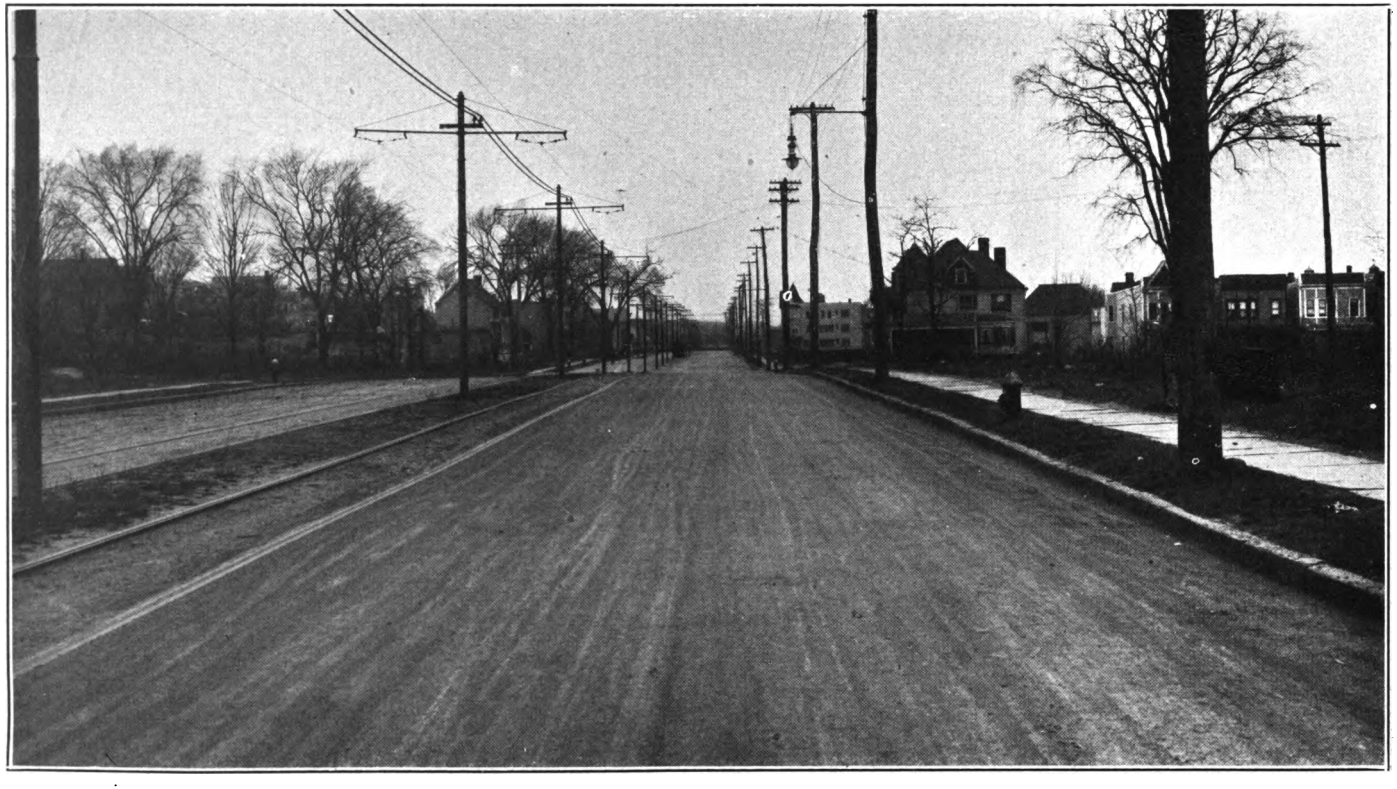

Section Sixteen—White Plains Road Experimental Pavement. Bermudez Road Asphalt Penetration Method. Completed.

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SECTION SEVENTEEN—White Plains Road Experimental Pavement. Standard Oil Binder B. Penetration Method, Before Applying Paint Coat.

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SECTION EIGHTEEN—White Plains Road Experimental Pavement. Standard Oil Binder A and Sand. Completed.

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